

What's making the difference in achieving outstanding primary school learning outcomes in numeracy?

SUSAN BUSATTO presents findings from a large NSW project designed to explore educational practices that 'make a difference' in numeracy outcomes. The project was coordinated by the NSW Department of Education and Training, the Catholic Education Commission, the Association of Independent Schools, and research teams from the University of New England, Southern Cross University, University of Technology, Sydney, University of Western Sydney, and the University of Wollongong.

This cross-sectoral research project set out to answer two simple questions:

- what are the educational practices which are 'making a difference' in enabling primary school students to achieve 'outstanding' numeracy learning outcomes?
- to what extent and in what ways can such educational practices be successfully applied to other school contexts?

During 2001 and 2002, case studies were conducted in forty-five government and non-government primary schools across NSW where 'outstanding' numeracy outcomes were being achieved at Years 3 and 5, and between Years 3 and 5, as indicated by Basic Skills Test data. These schools represented students from diverse socio-economic, language backgrounds other than English (LBOTE), Aboriginal and Torres Strait Islander (ATSI) and geographic communities (including isolated, metropolitan, rural, small and large schools). The sample comprised 70% Government, 20% Catholic and 10% Independent primary schools. Five university research teams were contracted to conduct the case studies in order to identify those factors that influenced student learning. The case studies included: interviews with teachers, parents, students, and community members; observations of numerous classroom mathematics/numeracy lessons; and the examination of many school documents.

The main factors which were found to be 'making the difference', as well as the strategies that enabled them to occur are grouped below according to three contexts: *within the classroom*, *throughout the school* and *beyond the school*. These factors and strategies seemed to fit together to provide a coherent guideline and philosophy for successful numeracy teaching.

Within the classroom

Factors making the difference

- Language as a focus for learning.
- Assessment to identify and accommodate difference.
- Purposeful pedagogy.

Strategies that enabled the above factors to occur

Strategies to enable learning through language

- Classroom organisation to enable learners to use talk to scaffold learning.
- Effective scaffolding in mathematics classrooms occurs when a learner works with a peer of higher skill development level in a group or in a pair or with a parent or teacher on a learning task that involves the manipulation of resources or a problem solving activity.
- Scaffolding is supported by questioning and modelling of strategies by the partner through these tasks.
- Expectations that learners will use oral and written language to explain strategies and justify conclusions.
- Questioning by both teachers and learners to establish, consolidate, extend, reinforce and reflect on concepts, skills and applications.
- Strong links between literacy and numeracy.

Strategies to assess and accommodate difference

- Assessment to identify and monitor individual abilities.
- Structures to manage different abilities through grouping or individualising learning which may be organised at a whole school (e.g., opportunity classes, graded mathematics classes, before or after mathematics sessions) or individual class level.
- Culturally differentiated pedagogy to address preferred learning styles or to build on cultural background.

Strategies to effect purposeful pedagogy

- Identifying specific outcomes as the lesson focus, linking indicators to outcomes, structuring explicit teaching steps to achieve outcomes within a lesson structure that is predictable — with an introduction, activity focus and conclusion.
- Resources that allow learners to manipulate concrete materials to construct their own understandings and use these resources in the application of concepts and skills.
- Opportunities to develop automaticity of basic facts and skills through drill and practice activities that are fun and usually implemented as an introduction to a lesson.
- Classroom management that is appropriate to the context of the school and consistent with school policy involving a strong, (but sometimes discreet) teacher presence.
- Strengthening of teachers' mathematical knowledge and pedagogical strategies through professional development.
- Opportunities for teachers to work collaboratively in planning and teaching to support innovation, sharing of ideas and resources.

Throughout the school

Factors making the difference

- A school commitment to numeracy.
- School policies that support numeracy.
- Specialised programs to support numeracy.

Strategies that enabled the above factors to occur

Strategies to effect a school commitment to numeracy

- Leadership to unify and direct.
- Collaborative development of a document to direct mathematics.
- School organisation to support mathematics through:
 - resourcing
 - timetabling
 - class organisation.
- Structures to cultivate collaboration between staff to facilitate communication and a cohesive sense of purpose.

Strategies to effect support policies

- Identification of areas that need to be addressed in mathematical teaching and learning through instruments such as parent and teacher surveys.
- Development, consistent implementation and school-wide monitoring of policies and particularly welfare policies.

Strategies to effect specialised programs to support mathematics

- The introduction of contextually and systemically appropriate structured programs particularly the *Count me in too* programs (including CMIT Indigenous program, *Counting on*, *Counting into measurement*, *Counting into space*).
- Special, school wide, programs to support learning in mathematics.

Beyond the school

Factors making the difference

- A shared 'vision'.
- Communicating about learning.
- Mathematics at home.

Strategies that enabled the above factors to occur

Strategies to effect a 'shared vision'

- Parent and community consultation in the development of the school's 'vision'. The development of clear goals.
- Programs to support parents' understanding of mathematics policies and practices.

Strategies for effective communicating about learning

- Formal reporting structures that provide opportunities for discussion.
- Portfolios that provide a comprehensive record of achievement and may include work samples, test results and reporting of outcomes.
- Informal reporting structures that enable parents and teachers to be informed of immediate issues.
- Homework is another way of reporting student progress.

Strategies for effecting use of mathematics at home

- Providing parents with the knowledge and skills to support mathematics at home.
- Staff conducting workshops that relate to new initiatives in numeracy.
- Homework that invites the participation of family rather than excluding it.

Applying the strategies to other school contexts:

The trialling schools — What is important

The second part of the project saw the application of these findings to a set of trial schools whose students' results in numeracy testing were below average. These schools were encouraged to focus on a few strategies that they identified as being most pertinent in their context. The strategies were easily understood by the teachers engaged with the project because they were well described from the outset. Some external support was also provided. Results from the trialling schools reinforced the findings from the rest of the study.

The numeracy strategies found to be 'making the difference' were not meant to be a 'recipe' for producing outstanding numeracy outcomes.

However there were a number of effective teaching strategies that emerged through the research process. These included:

- the use of hands-on materials to support the understanding and development of numeracy concepts;
- small group work to encourage discussion and exploration of ideas;

- use of open-ended questions by both teachers and learners to establish, consolidate, extend, reinforce and reflect on concepts, skills and applications;
- discussion during lessons to enable students to engage with and understand new and established mathematical concepts;
- catering for individual needs of students through consistent and varied assessment; differentiated teaching and learning; opportunities for interaction with the teacher, the support teacher or peers;
- collaborative planning among teachers which provided opportunities for innovative teaching; and
- whole school commitment to numeracy with all teachers implementing policies and programs consistently in all classrooms.

While a sample of these strategies was successfully implemented in each of the ten trialling schools, one of the key findings of the project was the importance of each school 'owning' what it had undertaken to do. This required trialling schools to bring knowledge of their own circumstances, opportunities and constraints to what they decided to do; and to support those directions from within their own resources and structures.

The schools which demonstrated greater than expected growth in numeracy achievement over the eighteen-month period were those that focussed on either the language of mathematics, or the engagement of practical resources to support concept development in numeracy. This suggests that the amount and clarity of discussion between students and teachers, and between students themselves, as well as carefully planned use of, resources are very important for improving numeracy learning.

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